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2,901,649

IMAGE STORAGE SCREENS AND METHOD OF MAKING SAME

Filed June 15, 1953

2 Sheets-Sheet 1

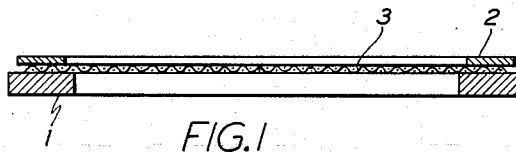


FIG. 1

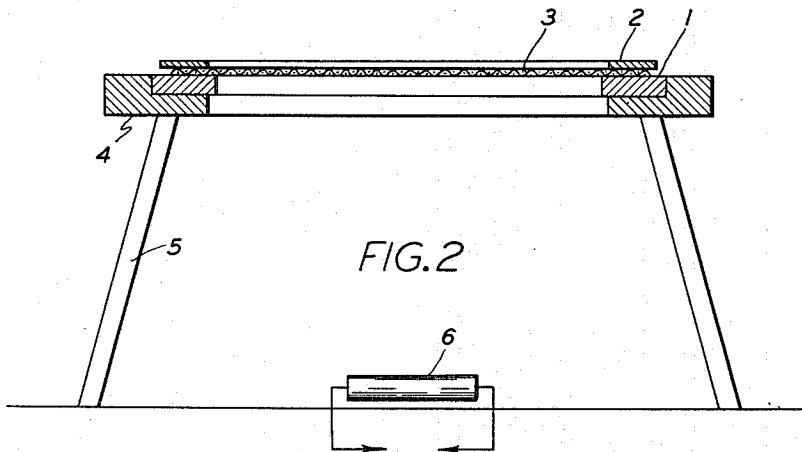


FIG. 2

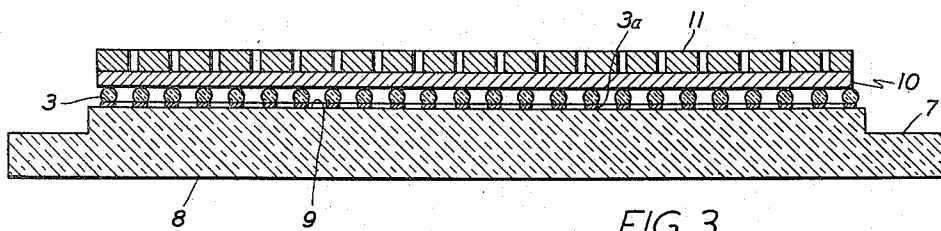


FIG. 3

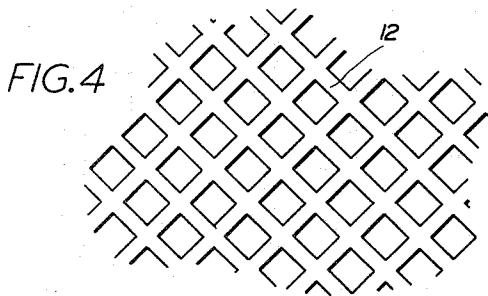


FIG. 4

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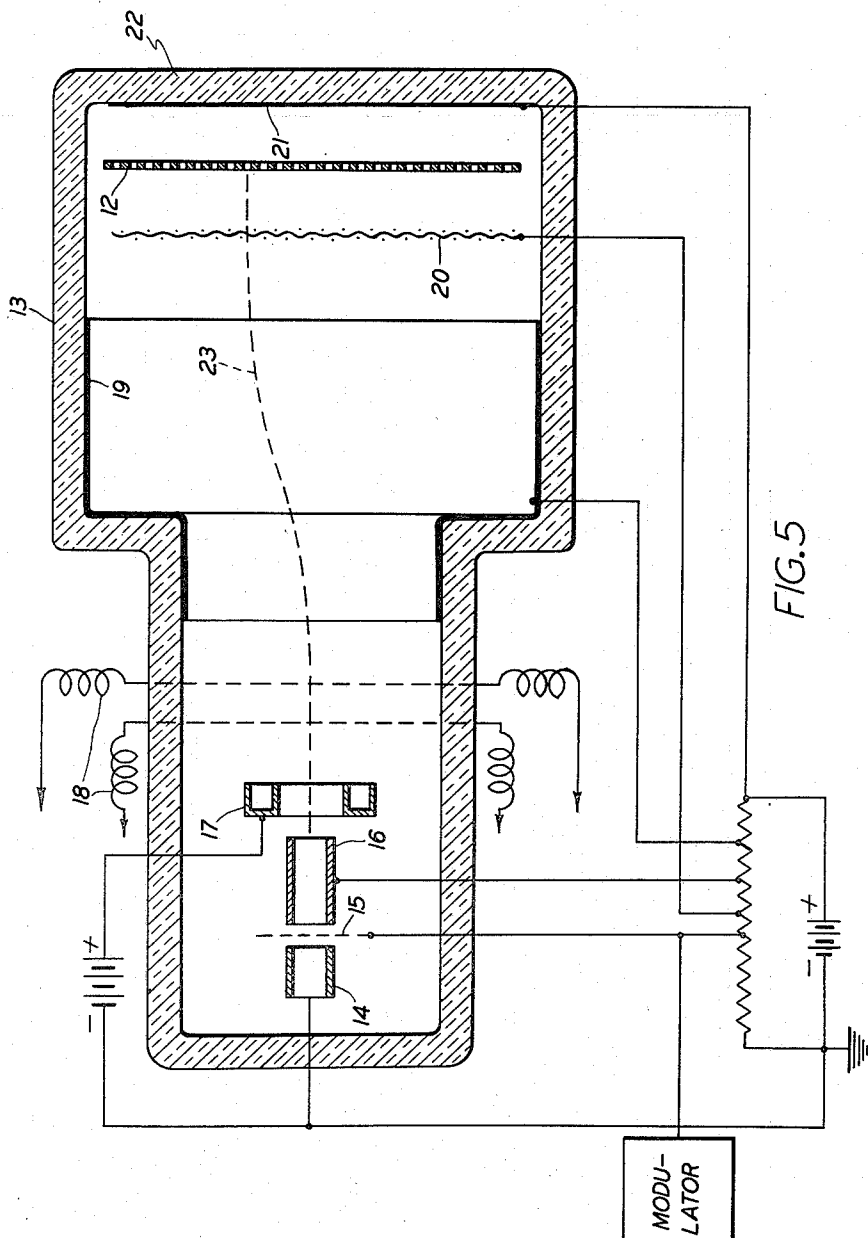
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IMAGE STORAGE SCREENS AND METHOD OF MAKING SAME

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2 Sheets-Sheet 2



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IMAGE STORAGE SCREENS AND METHOD OF MAKING SAME

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6 Claims. (Cl. 313—68)

The present invention relates to image storage screens, and particularly to unitary insulator screens for use in television image tubes and to the method of making such screens.

Television tubes employing the screen of this invention, may be of either the camera pick-up type or of the picture-reproducing type. One specific form of television tube with which the present invention may be used, is illustrated and described in the March 1953 edition of "Electronics" magazine on page 126. In such a tube as this, picture or image information is "written" on a planar storage screen composed of insulating material. Upon completion of the "writing," an electrical charge pattern is left on the surface of the insulator screen which for practical purposes may be considered as an electrical duplicate of the picture information written thereon. Since the screen is a good insulator, this charge pattern will remain on the screen for a considerable period of time, and by employing different known "reading" techniques, this information may be utilized to produce either a luminescent image or an electrical signal for utilization in the transmission of the picture information from one point to another.

At the present state of development, different types of storage screens have been proposed and used. One form comprises a metallic mesh backing which is coated with a suitable insulating material, such coating being limited to the metallic screen elements only thereby leaving the mesh openings unobstructed. Another form of storage screen, consists of an insulator only, such insulator being composed of silica as disclosed in Law Patent 2,572,497 issued October 23, 1951.

For certain purposes, each of these two forms of screens possesses an advantage over the other. For some purposes, the high capacity between the insulator coating and the metallic backing of the first-mentioned screen, is undesirable because of the inability to produce high differences of charge potential between the metallic screen and the coating surface. Included in this disadvantage, is the fact that considerable power is required to obtain a desired difference of potential on the screen thereby interfering with the tube operating characteristic of sensitivity.

The storage screen composed intirely of an insulating material such as silica, overcomes the disadvantage just explained by providing a fine mesh screen of low capacity, which may easily be imprinted with a charge pattern characterized by high differences of charge potential. The Law patent mentioned supra discloses such an insulator screen, but possesses the disadvantage of being extremely difficult to produce and extremely frangible in quality.

It is, therefore, an object of this invention to produce an insulator screen for use in television tubes, of improved physical characteristics and durability.

It is another object of this invention to provide a method for making such an insulator screen.

It is another object of this invention to provide a fine mesh insulator screen having low capacity for use in tele-

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vision tubes, such screen having more strength and resilience than any other similar screen of the prior art.

In accordance with the present invention, such an improved screen is provided by following the steps of evaporating a coating of silicon monoxide on one side of a flat metallic screen of desired mesh size, etching the metal away from the silicon monoxide coating, and heat treating the remaining silicon monoxide screen to relieve stresses and strains for increasing screen strength.

For a better understanding of the invention, together with other and further objects thereof, reference is made to the following description, taken in connection with the accompanying drawing, the scope of the invention being defined in the appended claims.

In the accompanying drawing:

Figure 1 is a cross section of a structure exemplifying one step in the method of this invention;

Figure 2 is a similar sectional view exemplifying another step in the method of this invention;

Figure 3 is a cross section of an assembly used in following the teaching of this invention;

Figure 4 is a fragmental section of an insulator screen achieved by means of the present invention; and

Figure 5 is a diagrammatic illustration of the present invention incorporated in a television tube.

At the outset, it is to be understood that the present invention comprehends the use and fabrication of screens of extremely fine mesh size, for example in the order of from 200 mesh to 1,000 mesh. With reference to Figure 1, a nickel or copper screen having a suitable mesh size, is applied to the upper surface of a metal ring 1. This screen may be of either copper or nickel composition, but in the preferred embodiment, nickel is used. Another metal ring 2 is superposed on the outer peripheral margin of the nickel screen 3 and welded thereto and also to the supporting ring 1 for securing the assembly together. As seen in Figure 1, in exaggerated form, the screen 3 is wrinkled, and since the final product must be substantially flat, it is necessary to remove the wrinkled condition by suitable heat treating. This may be accomplished by heating the assembly of Figure 1 in a hydrogen atmosphere at a temperature of 1400 degrees F. for twenty to thirty minutes. The assembly is then allowed to cool for a period of forty-five minutes, whereby the inherent shrinkage characteristics of the screen will cause it to tighten and straighten.

Next, the treated assembly of Figure 1 is mounted on a supporting structure illustrated in Figure 2. This supporting structure comprises a stepped supporting ring 4 which receives the ring 1 of the screen assembly, and suitable legs 5 for supporting the ring 4. A "boat" or metallic vessel composed of tantalum, indicated by the reference numeral 6, is placed on the floor of an evacuated container, such as a bell jar, in which the assembly at Figure 2 is placed. A charge of material, such as silicon monoxide crystals, which when heated will liberate silicon monoxide, is placed in the boat 6 in position to be exposed to the underside of the screen 3. An electrical current is passed through the boat 6 serving to heat the charge causing the liberation or evaporation of silicon monoxide, which flows upwardly toward the screen 3. This evaporating process is continued until a coating of silicon monoxide of three-tenths to four-tenths mil in thickness is deposited on the underside of the screen 3.

The screen assembly comprising a silicon monoxide coated nickel screen is removed from the bell jar and placed on a flat, fired lava disc 8 which is provided with a flat upper surface 9 and a stepped outer periphery as seen in Figure 3. This annular step, indicated by the reference numeral 7, receives the ring 1 of the screen assembly to position the silicon monoxide face 3a of the

metallic screen on the surface 9 of the disc 8. A piece 10 of filter paper approximately equal to the inner perimential size of the ring 1, is placed against the nickel screen backing and is wetted with distilled water. This filter paper should be of the lowest ash content possible and possess the highest degree of porosity. The mounting ring 1 is now cut away from the metal-insulator screen by the use of a surgeon's scalpel, or the like, leaving only the screen itself, backed by the wet filter paper, on the disc surface 9. After the mounting ring 1 has been removed, a heavy coarse stainless steel screen 11 is superposed onto the filter paper 10 thereby clamping the assembly together. It should be noted at this point in the process, that every care is exercised in order to avoid handling of the insulator coated screen 3, which would tend to bend or buckle it.

The assembly, as illustrated in Figure 3, is now immersed in a solution of either hydrochloric or nitric acid, this solution being of low concentration in order to obtain slow dissolution or etching away of the metallic screen. Specifically, a solution of ten percent nitric acid at room temperature has been found to perform satisfactorily. It has been found that the silicon monoxide coating on the screen is so frangible that active bubbling reaction between an acid and metallic screen backing will distort and sometimes fracture the silicon monoxide.

After the metallic backing screen has been completely etched away, the assembly is carefully rinsed with tap water. The stainless steel mesh 11 is removed and the assembly is again carefully rinsed with distilled water. With the filter paper 10 still in the assembly, a quartz or fired lava disc having a flat surface is placed against the filter paper. The resulting assembly resembles a sandwich with an unbacked insulator screen and filter paper between the smooth surfaces of the lava discs.

The assembly is now dried at a temperature of approximately 50° centigrade for approximately one hour. Then the temperature is gradually raised in a suitable oven containing an oxidizing atmosphere, to a temperature of approximately 700° centigrade. Temperatures in the range of 300° centigrade to 1100° centigrade have been used, but best results have been obtained by the use of temperatures ranging from 600° centigrade to 800° centigrade. This optimum temperature is held for about eighteen hours, the assembly then being allowed to cool slowly with the oven to approximately 100° centigrade. At this time, the compact, screen assembly, is removed from the oven. The filter paper will have burned out of the assembly leaving negligible ash. The insulator screen itself will tend to curl slightly, but by reason of the heat treatment, it may be gently handled with tweezers without breaking.

The final step involves the mounting of the insulator screen on a quartz supporting ring by the use of suitable cement, such as a 2% solution of potassium silicate. The mounted screen is then heat treated in air at a temperature of 500° centigrade for approximately thirty minutes to bake thoroughly the potassium silicate. The resulting product consisting of only a mounting ring and a solid insulator screen is now ready for use in a television tube structure.

Such a tube is diagrammatically illustrated in Figure 5 and the screen is indicated by the reference numeral 12. Mounted within the envelope 13 containing the screen 12 are a number of other conventional electrodes comprising a beam-forming cathode 14, a beam modulating grid 15, an accelerating electrode 16, an electron-flood cathode 17, suitable magnetic beam-deflecting coils 18, an accelerator electrode 19 which consists of a conductive coating on the inner wall of the envelope 13, a fine mesh metallic collector screen 20 which is mounted adjacent the cathode side of the storage screen 12, and a luminescent screen 21 provided on the end face plate 22 of envelope 13. All of these electrodes are provided with op-

erating potentials as illustrated and in a manner well known to the art.

In "writing" or forming a charge image on the storage screen 12, the beam of electrons, indicated by reference numeral 23, emitted by the cathode 14 is modulated and deflected in accordance with picture information conducted to the grid 15 and to the deflecting coils 18, for scanning the cathode side of the screen 12.

The potentials applied to the various electrodes are such as to impart a velocity to the electrons in the beam 23, which will produce greater than unity secondary emission from the impinged areas of the storage screen 12. Taking an elemental area of this screen 12 as an example, the electrons of the beam 23 modulated in accordance with the signal impressed upon the grid electrode 15, upon striking this elemental area, causes the emission of secondary electrons. A positive charge will be developed on this area depending upon the number of secondarily emitted electrons. Thus it is seen, that a charge pattern of positive polarity will be developed on the screen 12 in which the individual elemental area charges will have potential values respectively depending upon the velocity or beam density of the beam 23.

Upon completing a scan of the screen 12, the cathode 17 is caused to emit a flood of low velocity electrons, which covers the entire storage screen area, the electrons passing through the mesh openings to impinge upon the luminescent screen 21. Since the charge areas around the individual mesh openings in the screen 12 vary in accordance with the electrical image stored thereon, the flood electrons passing through any given mesh opening will be modulated in accordance with such charge and will transfer this modulation to the luminescent screen 21. By this means, a visible image is produced by the screen 21 in a manner well known to the art.

As mentioned earlier, the advantage residing in the use of an insulator screen of this invention is primarily due to the low capacity thereof. This property enables the electron beams 23 to produce relatively high differences of charge potential on the elemental areas of the screen 12. A low capacity electrode of this type greatly increases the sensitivity and picture contrast, and, therefore, provides a picture of greater fidelity.

As compared to prior constructions, the storage screen produced by following the teachings of this invention is composed of solid strands rather than hollow ones as obtained in following the process of Law Patent 2,572,497. The screen of the present invention is also stronger and less frangible.

What is claimed is:

1. The method of forming a fine mesh image storage screen comprising the steps of evaporating in a vacuum a coating of silicon monoxide on one side only of a metallic screen, etching said metallic screen away leaving only said coating of silicon monoxide in the form of said metallic screen, and heat treating the silicon monoxide screen at a predetermined temperature and for a predetermined period of time to reduce its frangibility.

2. The method of forming a fine mesh image storage screen comprising the steps of evaporating in a vacuum a coating of silicon monoxide on one side only of a metallic screen, placing the coated screen in an acid bath to remove the metallic screen and to form a unitary silicon monoxide screen, and heat treating the silicon monoxide screen at a predetermined temperature and for a predetermined period of time to reduce its frangibility.

3. The method of forming a fine mesh metallic screen comprising the steps of flattening a metallic screen, evaporating in a vacuum a coating of silicon monoxide on one side only of said screen, simultaneously etching the metallic screen away and maintaining the resulting unitary silicon monoxide screen in flattened condition, and heat treating the silicon monoxide screen under such conditions as to at least partially convert it to silicon dioxide while maintaining it in flattened condition.

4. A fine mesh storage screen having strands composed predominantly of silicon monoxide and having a mesh size of between about 500 mesh and 1000 mesh, the physical characteristics of such screen being such as to permit its handling for affixation to a supporting structure, said strands being solid and without cracks.

5. The method of forming a fine mesh image storage screen comprising the steps of evaporating in a vacuum a coating of silicon monoxide on one side only of a metallic screen, dissolving the metallic screen in an acid bath of low concentration which will not cause bubbling to an extent which will fracture the coating of silicon monoxide, and heat treating the silicon monoxide screen at a temperature and for a period of time which will reduce the frangibility thereof.

6. The method of forming a fine mesh image storage screen comprising the steps of: applying a fine mesh metal screen to a metal ring; securing said metal screen to said ring; heating said screen and ring assembly at an elevated temperature for a predetermined time and subsequently cooling the same thereby to tighten and straighten said metal screen; supporting said metal screen and ring assembly above a receptacle in a container; placing a quantity of silicon monoxide in said receptacle; evacuating said container; heating said silicon monoxide in said receptacle to evaporate said silicon monoxide onto the surface of said metal screen facing said receptacle, thereby to coat said surface with silicon monoxide; removing

said metal screen and ring assembly from said container and placing the same onto a flat disc of material having low heat conductivity with said silicon monoxide coating abutting said disc; placing a piece of relatively thin paper on top of said metal screen; cutting said ring away from said metal screen; placing a relatively heavy coarse metal screen on top of said paper; immersing the assembly in a low concentration acid solution thereby to etch away said metal screen; removing said coarse metal screen; placing a flat disc of material having low heat conductivity against said paper; placing the assembly in an oven and heating the same at an elevated temperature in an oxidizing atmosphere for a predetermined time; cooling the assembly; removing the flat discs from the silicon monoxide screen; mounting said silicon monoxide screen on a support ring; and heat treating the mounted screen for a predetermined time.

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